

## RESILIENT ELEMENT

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates to a resilient element,  
5 more particularly to a surface mountable resilient  
conductive element that has a simple and durable  
construction.

#### 2. Description of the Related Art

Referring to Figures 1 and 2, a conventional surface  
10 mountable resilient conductive element 1 is shown to  
be formed from a unitary conductive strip that is made  
of metal and that is bent to configure the resilient  
conductive element 1 with a planar top portion 12, a  
planar bottom portion 10 disposed below and parallel  
15 to the planar top portion 12, an inclined arm portion  
11 that interconnects a rear end of the planar top portion  
12 and a front end of the planar bottom portion 10, an  
upper extension portion 14 that extends downwardly,  
inclinedly and rearwardly from a front end of the planar  
20 top portion 12 through a lower hole 112 in the inclined  
arm portion 11, and a lower extension portion 13 that  
extends upwardly, inclinedly and forwardly from a rear  
end of the planar bottom portion 10 through an upper  
hole 111 in the inclined arm portion 11. Each of the  
25 upper and lower extension portions 14, 13 is formed with  
a distal curved end 141, 131. The planar top portion  
12 is adapted to be acted upon by a suction device (not

shown) for moving the resilient conductive element 1 during a surface mounting operation.

As shown in Figure 3, when the planar top portion 12 is subjected to a downward force, elastic deformation of the resilient conductive element 1 occurs at the junctions of the planar top and bottom portions 12, 10 with the inclined arm portion 11. As the planar top portion 12 moves toward the planar bottom portion 10, the distal curved ends 141, 131 of the upper and lower extension portions 14, 13 eventually abut against the planar bottom and top portions 10, 12, respectively, thereby resulting in increased resistance to further deformation of the resilient conductive element 1. On the other hand, since the resilient conductive element 1 is used for making electrical or grounding connection between an electrical device (not shown) thereabove and a contact pad (not shown) of a circuit board (not shown) therebelow, when the planar top portion 12 is pressed toward the planar bottom portion 10, a reduction in contact resistance results in view of contact between the planar top and bottom portions 12, 10 and the distal curved end 131, 141 of the respective one of the lower and upper extension portions 13, 14.

The following are some of the drawbacks of the aforesaid conventional resilient conductive element 1:

1. The mechanical strength of the resilient conductive element 1 is compromised in view of the presence of the

upper and lower holes 111, 112 in the inclined arm portion 11.

2. Manufacturing of the resilient conductive element 1 is done manually and cannot be automated due to the need to extend the upper and lower extension portions 14, 13 through the lower and upper holes 112, 111 in the inclined arm portion 11, which results in low production efficiency, poor precision, and increased costs.

3. Since the resilient conductive element 1 is bent by hand, it is not possible to shrink the size of the resilient conductive element 1 further.

#### **SUMMARY OF THE INVENTION**

Therefore, the object of the present invention is to provide a resilient element that can overcome the aforesaid drawbacks of the prior art.

Accordingly, a resilient element of the present invention comprises interconnected lower and upper parts. The lower part includes a planar bottom segment having front and rear ends, a first curved segment that curves upwardly and rearwardly from the front end of the planar bottom segment, and a second curved segment that curves upwardly and forwardly from the rear end of the planar bottom segment. The upper part includes a planar top portion that has front and rear ends and that is disposed above and substantially parallel to the planar bottom segment, a first curved portion that

curves downwardly and rearwardly from the front end of the planar top portion and that is disposed above the first curved segment, and a second curved portion that curves downwardly and forwardly from the rear end of the planar top portion and that is disposed above the  
5 second curved segment. The first curved segment and the second curved portion have interconnected distal ends.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the present  
10 invention will become apparent in the following detailed description of the preferred embodiment with reference to the accompanying drawings, of which:

Figure 1 is a perspective view of a conventional resilient conductive element;

15 Figure 2 is a sectional view of the conventional resilient conductive element;

Figure 3 is a sectional view to illustrate a compressed state of the conventional resilient conductive element;

20 Figure 4 is a perspective view of the preferred embodiment of a resilient element according to the present invention;

Figure 5 is a sectional view of the preferred embodiment; and

25 Figures 6 and 7 are sectional views to illustrate compressed states of the preferred embodiment.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring to Figures 4 and 5, a resilient element according to the present invention is shown to be embodied in a surface mountable resilient conductive element 2 that is formed from a unitary conductive strip made of metal and bent to configure the resilient conductive element 2 with interconnected lower and upper parts 20, 27. The lower part 20 includes a planar bottom segment 21 that has front and rear ends 210, 211, a first curved segment 22 that curves upwardly and rearwardly from the front end 210 of the planar bottom segment 21, and a second curved segment 23 that curves upwardly and forwardly from the rear end 211 of the planar bottom segment 21. The upper part 25 includes a planar top portion 26 that has front and rear ends 260, 261 and that is disposed above and substantially parallel to the planar bottom segment 21 of the lower part 20, a first curved portion 27 that curves downwardly and rearwardly from the front end 260 of the planar top portion 26 and that is disposed above the first curved segment 22 of the lower part 20, and a second curved portion 28 that curves downwardly and forwardly from the rear end 261 of the planar top portion 26 and that is disposed above the second curved segment 23 of the lower part 20. The first curved segment 22 of the lower part 20 and the second curved portion 28 of the upper part 25 have interconnected distal ends 221, 281. In

addition, each of the second curved segment 23 of the lower part 20 and the first curved portion 27 of the upper part 25 has a distal end 231, 271.

Referring to Figure 6, when the planar top portion 26 is subjected to a slight downward force, elastic deformation of the resilient conductive element 2 occurs initially at the second curved portion 28 of the upper part 25 and the first curved segment 22 of the lower part 20 such that the second curved portion 28 and the first curved segment 22 are brought into contact with the distal ends 231, 271 of the second curved segment 23 and the first curved portion 27, respectively. As a result, the Young's modulus of the resilient conductive element 2 is increased to result in increased resistance to further deformation of the resilient conductive element 2. As shown in Figure 7, even when the downward force applied on the planar top portion 26 is increased, the planar top portion 26 is prevented from coming into contact with the planar bottom segment 21 to minimize the risk of permanent deformation of the resilient conductive element 2. Moreover, contact among the distal ends 231, 271 of the second curved segment 23 and the first curved portion 27, the second curved portion 28 of the upper part 25, and the first curved segment 22 of the lower part 20 results in additional conductive routes, which reduce contact resistance of the resilient conductive element 2 from 5-7 m $\Omega$  to 2-3 m $\Omega$ .

Since the entire length of the resilient conductive element 2 is not formed with any hole therethrough, the mechanical strength thereof is not compromised. Moreover, in view of its simple structure, it only  
5 requires one punching operation and four bending operations to fabricate the resilient conductive element 2. Therefore, the resilient conductive element 2 can be fabricated in an automated manner to result in higher production efficiency, good precision, and  
10 lower costs. Moreover, since bending need not be conducted by hand, the size of the resilient conductive element 2 can be shrunk further to comply with current trends toward miniaturization.

It should be noted herein that, while the shapes of  
15 the first and second curved segments 22, 23 of the lower part 20 are shown to be generally symmetrical to those of the first and second curved portions 27, 28 of the upper part 25 in the disclosed embodiment, those skilled in the art can appreciate that the shapes thereof should  
20 not be limited thereto and can be actually modified in practice.

While the present invention has been described in connection with what is considered the most practical and preferred embodiment, it is understood that this  
25 invention is not limited to the disclosed embodiment but is intended to cover various arrangements included within the spirit and scope of the broadest

interpretation so as to encompass all such modifications  
and equivalent arrangements.